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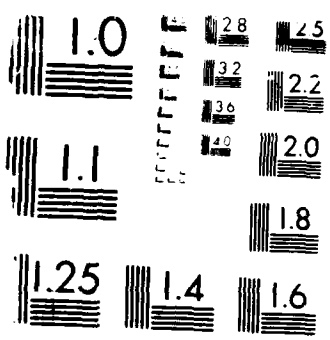
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PLASMA JOINING OF METAL MATRIX COMPOSITES

Submitted to U.S. Army Research Office

Contract No. DAAG29-85-C-0027

Interim Technical Report February-May 1987

Prepared by:
G.H. Reynolds and L. Yang, MSNW, Inc.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Al-8 Zr-30 SiC (wt.%) and Al - 8 Ti - 30 SiC (wt.%) composite powder filler metals prepared for butt welding of Al/SiC composite base plates to be used for weldment mechanical property studies are described.

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ABSTRACT

Al-8 Zr-30 SiC (wt.%) and Al - 8 Ti - 30 SiC (wt.%) composite powder filler metals prepared for butt welding of Al/SiC composite base plates to be used for weldment mechanical property studies are described.

EXPERIMENTAL RESULTS

Two composite powder filler metal compositions were prepared in moderate (ca. 1 kg) quantities for use in preparation of larger scale butt welds in Al/SiC composite base plates. The compositions (in wt.%) prepared were Al-8Zr-30 SiC and Al-8Ti-30SiC. Powders were prepared by high energy milling of mixtures of aluminum, Al_3Zr, TiAl and SiC particulates, respectively, in inert environments. The powders were milled to macroscopic homogenization as shown in Figures 1 and 2. Final homogenization of the matrix composition is expected to occur during plasma deposition.

Each composition was designed to provide higher reactive metal concentrations than have been used previously while maintaining a two-phase (Al(Zr) - Al_3Zr and Al(Ti) - Al_3Ti, respectively) matrix microstructure. This represents an attempt to maintain a reasonably ductile matrix phase while providing sufficient reactive metal concentration for suppression of interfacial Al_4C_3 formation during plasma processing. The Al-Zr and Al-Ti phase diagrams are shown in Figure 3. Note the Al-11.4 wt.% Zr and Al-11.4% wt.% Ti matrix phase compositions lie in two-phase regions.

These composite powder fillers have been used to prepare low pressure, transferred arc plasma process butt welds in 6061-25 wt.% SiC_p base plates using procedures similar to those described previously but with much thicker (ca. 0.125-0.250 in. thick) deposits in the butt joints. The welded composite plates are presently undergoing as-welded mechanical property testing for quantification of bond line mechanical properties.

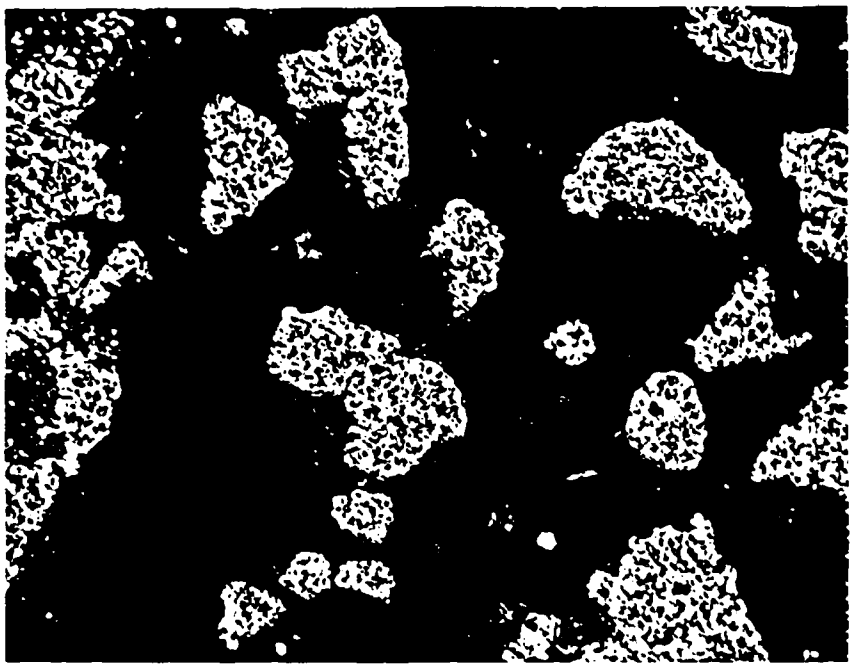


Figure 1. Metallographic cross sections of as-prepared Al - 8 Zr - 30 SiC (wt.%) composite filler metal powder particles. Magnification 500X.

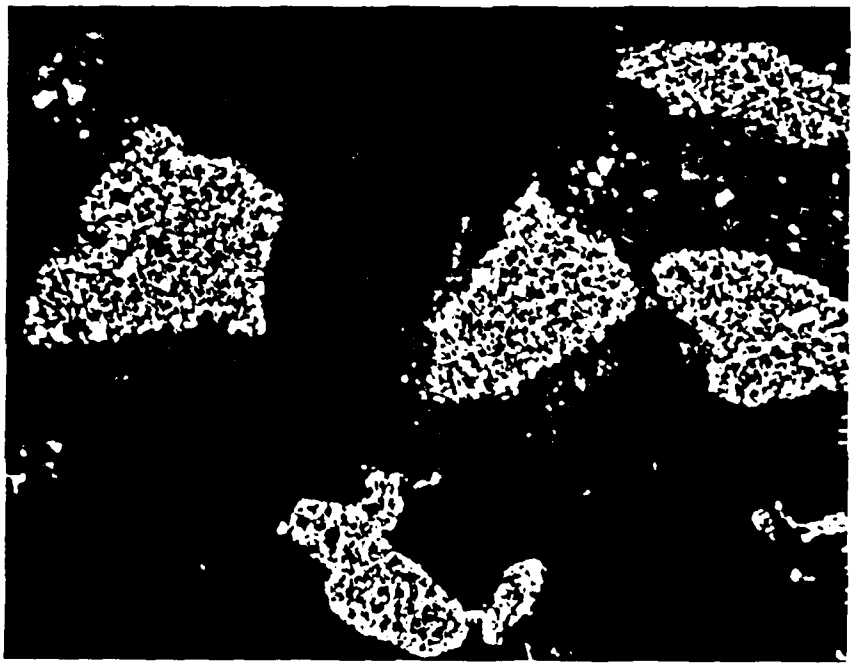
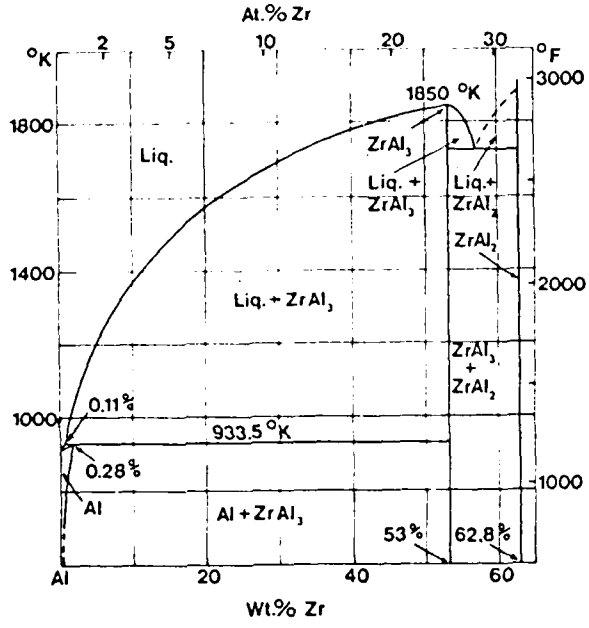
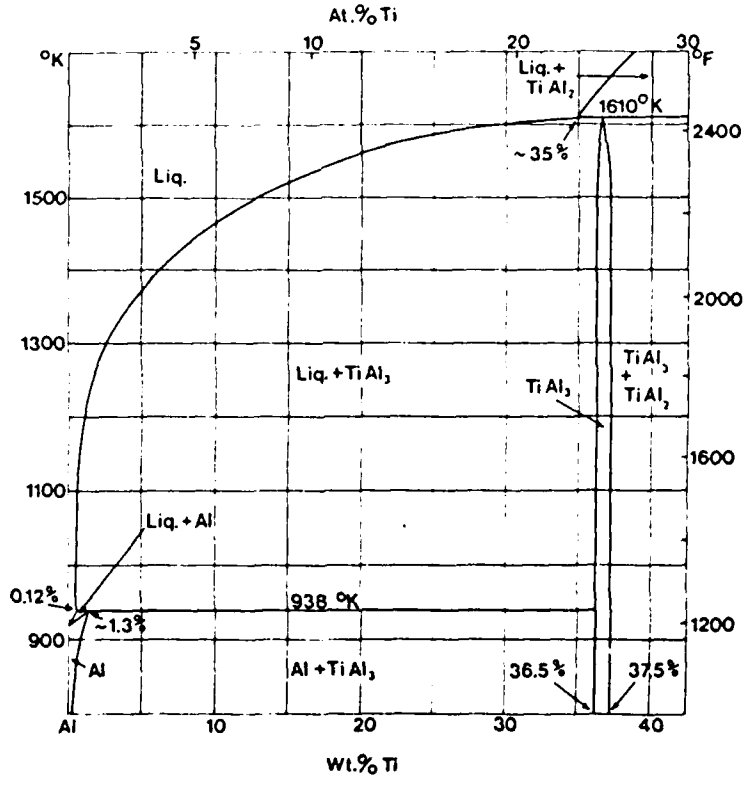


Figure 2. Metallographic cross sections of as-prepared Al - 8 Ti- 30 SiC (wt.%) composite filler metal powder particles. Magnification 500X.



The aluminum end of the aluminum–zirconium equilibrium diagram



The aluminum end of the aluminum–titanium equilibrium diagram

Figure 3. Al-Zr and Al-Ti phase diagrams.

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